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CULTIVATION OF TOBACCO IN THE PHILIPPINE ISLANDS

BY

B. E. BREWER

TOBACCO SPECIALIST

FARMERS' BULLETIN No. 16

THE GOVERNMENT OF THE PHILIPPINE ISLANDS
DEPARTMENT OF PUBLIC INSTRUCTION
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CULTIVATION OF TOBACCO IN THE PHILIPPINE ISLANDS.

INTRODUCTION.

Tobacco, at the present time, ranks fourth among the exports of the Philippine Islands. Manila cigars have become favorably known throughout the civilized world; but, until recently, their use has been confined principally to the countries of the Far East and Europe. The passage of the Payne Tariff Bill has opened a new market for Philippine tobacco, and during the past year about 86,000,000 cigars have been exported from these Islands to the United States. This increased demand has resulted in an advance of from 40 to 80 per cent in the local prices of leaf tobacco, and the opportunities for the Philippine tobacco planter are now very favorable. If these conditions are to continue, it is essential that more attention be given to the production of the better grades of tobacco that are demanded by the American market.

In certain sections of the Philippine Islands the climatic and soil conditions are exceptionally favorable for the production of a superior grade of tobacco; but, owing to the low prices formerly received for their tobacco, the Philippine planters have given but little care to its cultivation or improvement. Little or no attention has been paid to the selection of good seed, the cultivation of the plant, or the proper curing of the leaf. The present status of the industry makes it imperative that improved methods be introduced if tobacco growing in the Philippines is to prosper.

SOIL AND CLIMATE.

Tobacco is grown to a limited extent in all the principal islands of the Philippine Archipelago, but the bulk of the commercial supply is produced in the provinces of Isabela and Cagayan, situated in the northern part of the Island of Luzon, in the Province of La Union, in central Luzon, and in the Island of Cebú.

While the tobacco plant will grow on nearly all kinds of soil, the texture of the leaf produced depends largely upon the class of soil on which it is grown. If the soil is dark, heavy, and poorly drained, the leaves of the plant will be dark in color, thick, and coarse veined.

If the soil is light and well drained, the leaves will be light in color and elastic.

Climate, also, has an influence on tobacco, in that it determines in part the flavor, aroma, and burning qualities of the leaf. Tobacco grown near the sea is of no value as a cigar tobacco. This is because the sea air contains a certain amount of chlorin. Whenever chlorin enters into the composition of the tobacco leaf it injures its burning qualities, one of the most important qualities of cigar tobacco.

The soils in Cagayan province are almost identical with those in Isabela province, but the tobacco grown in Isabela is acknowledged to be far superior to that produced in Cagayan. This may be explained by the fact that the larger part of Cagayan province is exposed to the sea breezes. Isabela province being farther in the interior and surrounded by high mountains which exclude the sea air, produces a better quality of tobacco. The demand for Isabela tobacco is greater than that for the tobacco grown in Cagayan province.

Along the Cagayan Valley there are two, and in some places three, distinct flood plains. The lower flood plains are usually inundated several times during each season, and the flood waters carry much fine material gathered from the slopes lying within the basin of the river. When the river overflows its immediate banks, the current is checked by shrubs, grasses and other obstructions. By reason of this loss of velocity much of the material carried down by the water is deposited over the land in the form of sand and fine alluvial silt which is exceptionally rich in plant food. Hence soils of these flood plains vary considerably in composition and fertility from a light sandy loam, deposited by the swift current, to a dark alluvial clay deposited by slower currents, and are, therefore, adapted to the production of different types of tobacco.

Certain districts of Cebu and Panay have a very fertile soil which is adapted to the growth of tobacco; but, owing to the influence of the sea air only a small quantity of leaf having good burning qualities can be produced in these provinces.

PREPARATION OF SEED BEDS.

The first step in connection with the growing of a tobacco crop is the selection of a suitable location and the preparation of the seed bed.

The making of the seed bed is of great importance and neither time nor labor should be spared, as the failure to have an abundant supply of good strong plants may cause a partial or total failure of the crop.

The seed bed should not be located where there is danger of its being destroyed by floods or heavy rains. Many Filipino planters persistently place their seed beds along the banks of rivers where they are often destroyed by the high waters which are of frequent occurrence during the

season of the year when seed beds should be planted. As the cost of transportation of plants for some distance would be very small, it would be better to go a considerable distance from the field intended for tobacco in order to secure a location having a suitable soil, sufficiently elevated, and yet near a small stream that will furnish water for the young plants.

The nature of the soil is a very important factor in the production of good healthy plants. The best kind of soil for a seed bed is a rich, black virgin loam; such soils can generally be found in the forest. In regions where forests are scarce, plots covered with a dense growth of shrubbery make a very desirable location.

After a suitable location has been selected, all undergrowth should be removed and the soil broken up to a depth of twelve or fifteen centimeters, exposing the roots of grass and weeds to the sun. This preliminary work should be done one month before planting time, then all roots, sticks, and other waste material removed and the soil thoroughly pulverized. The soil should then be sterilized (or heated) in order to kill the insects and seeds of grass and weeds that are liable to interfere with the growth of the young plants.

This sterilization of the soil may be accomplished in different ways, but the most practical method is to burn brush or logs on the surface of the ground. In using brush it should be placed on the bed in a layer not over one meter high, and the fire started on the leeward side in order that it may burn slower and the heat have a better chance to penetrate the soil. A slow, steady fire will heat the ground better than a quick one. If the brush is dry better results will be obtained. The ashes from the burned material furnish a good fertilizer for the young plants.

After the soil has cooled off, it should be finely pulverized again and made into low ridges, 8 or 10 centimeters high, 1.5 meters wide, and as long as desired, leaving a small foot path between them, thereby insuring drainage.

SOWING THE SEED.

Tobacco seeds are very small and it is a difficult matter to scatter them evenly over the bed so as to get a uniform stand of plants. It is advisable, therefore, to mix the seed before sowing with a few handfuls of corn meal or dry ashes. The use of meal is also a partial protection against ants, which will be occupied carrying away the meal while the tobacco seeds are sprouting.

Many planters make a great mistake in using too large a quantity of seed, and as a result the plants are so crowded in the bed that they run up a long spindling stalk and have such low vitality that many of them die on being transplanted to the field. Those which do survive require several weeks to get a firm hold in the soil and start growing.

It is far better to make the mistake of using too small a quantity of seed, for in the latter instance the plants will be large, healthy and stocky, and may be transplanted to the field when there is but little moisture in the soil, without danger of losing them.

In other tobacco-producing countries a seed bed containing 50 square meters, properly sown with about 30 grams of good seed (about $\frac{1}{2}$ of 1 chupa), will produce from 10,000 to 20,000 plants, but the Filipino planter, in order to secure this number of plants, generally sows an area of 150 square meters, using from 1.5 to 2.5 kilos of seed. Thirty grams of tobacco seed contain from 300,000 to 400,000 seeds. A large percentage of these, however, will not germinate; yet, allowing for the imperfect seeds, from 40,000 to 50,000 plants should be secured from 30 grams of good seed. Many of these plants, however, will be weak and unhealthy and should not be transplanted. It is advisable to sow two or three beds at intervals of eight or ten days, in order that there may be plenty of good, healthy plants to select from, and if one bed should be destroyed by a flood or insects the other beds will supply an abundance of plants for the crop.

SHADING THE SEED BEDS.

The main objects in shading the plant bed are, to protect the young plants from the strong rays of the sun, and to conserve the moisture on the surface of the bed.

In America, Cuba, and Sumatra, a special cloth is manufactured for shading tobacco seed beds; and, if properly arranged, it not only gives the desired shade, but also protects the young plants from the attack of insects. The young tobacco plants are very shallow rooted and when the bed is not protected by a shade, two or three days' strong sun is sufficient to dry out the surface of the ground below the depth to which the roots have penetrated.

In the Visayan Islands the tobacco planters generally use the leaves of the nipa palm for constructing shades for their plant beds. In the Cagayan Valley shading is not practiced, and the plants, exposed to the direct rays of the sun, are frequently killed. In case of a prolonged drouth the grower loses all of his plants and must either depend upon his more fortunate neighbors, or else forego the privilege of growing a crop of tobacco for that year. In using the leaves of the nipa palm for shading seed beds, forked sticks should be driven in the ground on both sides of the bed, at intervals of every two or three meters, leaving about one meter of the stick projecting above the surface. Good strong poles should then be cut and placed across the bed with the ends resting in the forks, and the leaves placed on these poles. In the absence of nipa,

PLATE I. PLANT BED IN KENTUCKY, SHOWING CANVAS STRETCHED OVER TOBACCO SEEDLINGS.

a suitable shade may be constructed from a lattice-work of bamboo, and if kept dry when not in use, these bamboo shades will last for several years.

After the plants have developed three or four leaves, and are almost large enough to transplant, the covering used as a shade should be removed about 5 p. m. and replaced about 9 a. m. After following this practice for several days, the shade may be entirely removed, in order that the plants may become accustomed to the sunlight and be in better condition to stand the exposure when transplanted to the field.

PREPARATION OF SOIL.

With the native plow that is universally used by the Filipino planters in the preparation of their soil, it is impossible to satisfactorily turn under the weeds, grass, and trash. All vegetable matter is, therefore, either piled and burned, or, if too green to burn, is carried to the edge of the field. A large amount of valuable material is thus wasted, which, if properly turned under and allowed to decay, would add greatly to the fertility and water-holding capacity of the soil. A great improvement could be made by using modern plows which would not only turn under the vegetable matter, but also make it possible to prepare the field more rapidly than with the native plow. With the native plow it is necessary to plow and cross-plow the field several times before the soil is in suitable condition for planting.

Land that is not subject to inundation should be plowed six or eight weeks before the time for planting, in order that the clods may be broken up by the rains. Just before planting, another plowing should be given the field. As a general rule where the field is plowed early and allowed to lie for some time the clods are dried out by the sun and cracks are formed in them. A slight rain will fill these cracks with water and as this moisture is evaporated by the sun, the clods will crumble into a finely pulverized state. If the second plowing is given just before planting, and a harrow run over the surface of the field, the soil will be finely pulverized and the cultivation of the crop made much easier.

In districts where the land is subject to overflow, like the lower flood plains of the Cagayan Valley, it is impracticable to prepare the soil any length of time before planting, because if the soil is loosened it is liable to be carried away by the floods.

No general rule can be given as to the proper time for plowing the land, and each planter must be governed largely by the nature of his soil and the condition of the weather.

No land should be plowed while it is too wet; clayey soil plowed while too wet bakes into hard clods which interfere with the cultivation of

the field after the tobacco is planted. But the mistake should not be made of waiting too long after the rains to begin plowing, as the surface of the soil bakes, making it difficult to plow.

TRANSPLANTING.

Marking off the ground in rows is the final operation before transplanting, and the distance apart the plants should be placed depends largely upon the type of tobacco desired. The quality of tobacco the planter desires to produce must be taken into consideration, both in marking off the rows, and in transplanting the plants in the rows. Since a sandy loam is better adapted to the production of a fine, thin, elastic leaf, suitable for wrapper purposes, the plants should be placed close in the rows when grown on such land. Where the soil is heavy and contains clay, it is better adapted to the production of leaves suitable for filler purposes. On such soils the rows should be farther apart and the plants should be placed farther apart in the rows, in order that the leaves may have room to develop.

Under favorable conditions tobacco plants should be large enough to transplant in from six to eight weeks from the time of sowing the seed bed, and as soon as the plants are large enough, they should be transplanted.

Before drawing any plants from the bed it should be wet thoroughly, unless this has just been done by a good rain. Draw the plants one at a time. Leave the smaller plants for future plantings. In drawing the plants from the bed, never catch hold of the bud or stem, but always by the leaves above the bud. If the leaves are slightly bruised this does not hurt the plant, but if the bud or stem is injured the growth of the plant is greatly retarded and it frequently dies from the effects of the injury.

After the plants are drawn from the bed they should be protected from the sun, and transplanted as soon as possible. If kept out of the soil for any length of time they lose their vitality.

Transplanting should never be done while the sun is very hot or the soil dry. The best time for transplanting is in the late afternoon and at night, this gives the roots of the plants time to secure a hold in the soil before they are exposed to the hot rays of the sun.

If the weather is not cloudy at the time of planting, it is advisable to shade the plants for a few days. This may be done by laying banana leaves over the plants. This not only shades the plants, but also tends to conserve the much needed moisture around their roots.

CULTIVATION.

Few plants respond more readily to favorable soil conditions and thorough culture than does tobacco, and there is certainly no other crop that requires more attention in its cultivation if it is to be grown to perfection.

Owing to the variation of the seasons it is impossible to give any strict rules for the cultivation of tobacco and the planters must learn from practical experience the best time for cultivating the fields.

The principal reasons for cultivating tobacco are to keep the soil in good physical condition, prevent the growth of weeds, give a larger feeding area to the root system, and to conserve the moisture in the soil. These conditions not only help to determine the quality of tobacco produced, but the yield of the crop depends largely on the manner in which the soil is treated during the growing period of the plants.

Tobacco is a lateral root feeder and the conservation of moisture is one of the most important matters in its development. The moisture can easily be retained in a finely pulverized soil by frequently stirring the top soil with a plow. The moisture in the ground does not pass easily through this freshly stirred soil. If the soil is cloddy, the moisture escapes very rapidly during a dry period and it is almost impossible to conserve moisture under such conditions.

Under favorable conditions the young tobacco plants will secure a firm hold in their new position and start to growing in from five to ten days from the time of transplanting. The first cultivation should then be given by plowing deep and close to the rows in order to loosen the soil and allow the roots to penetrate easily. The succeeding cultivations should be shallow near the rows and deeper in the center, so as not to disturb the roots of the plants. The field should be cultivated at least once a week throughout the entire growing season.

Should heavy rains fall during the early growing period of the plants, a deep furrow run in the middle of the rows will tend to drain the excess water away from the plants. Owing to the fact that the rainy season is generally over by the time the transplanting is finished, it seldom happens that the plants suffer from an excess of moisture in the soil. On the other hand the yield of the crop is frequently reduced on account of the drouths that often occur during the growing period.

Where the native plow is used in cultivating the tobacco field, it is necessary to make several trips in the same row in order to stir the soil sufficiently. A modern cultivator, which is especially adapted to the cultivation of tobacco, can be obtained for about \$20, and with such a cultivator the row can be thoroughly cultivated in one trip.

FIG. 1. INSECT TRAP.

INSECTS.

A large part of the annual losses of the tobacco growers is due to the attacks of injurious insects which feed upon the growing plants in the field.

There are many different kinds of insects which attack the growing plants. The principal one, or rather the one responsible for the greatest damage, is almost identical with the "false bud worm" of the United States. This caterpillar is about 2.5 centimeters in length and is pea-green in color. Generally its work is first noted in the tender leaves of the terminal bud. Later, the worm wanders among the leaves and eats holes in them in different places. Sometimes it is not satisfied with doing this, but eats off the small axillary bud and keeps eating in a downward direction in the stalk until it reaches a depth of 10 or

12 centimeters. When this method of feeding is resorted to, the greatest damage results, as the rain generally fills up the hole, and unless the plant is very vigorous the stalk rots and dies. The second brood of caterpillars often operate on the blossoms and seed pods of the plants. When feeding on the blossoms the corolla alone is generally eaten. The seed bolls are attacked shortly after the young seeds are formed and while they are still soft, a hole is gnawed into the side of the seed pod and the placenta, on which the seeds are borne, and many of the seeds are destroyed; then the caterpillar withdraws and continues operations on another pod.

Individuals of this species do not confine their attention to tobacco alone, but also feed on tomatoes, corn, and cotton. As the tobacco crop of the Cagayan Valley is followed by one of corn, the conditions are ideal for the propagation of this species. When operating on corn, the eggs are laid on the silk of the young ears and the worm eats its way inward, feeding upon the kernels of the ear.

Different methods of controlling this species have been tried. Arsenate of lead sprayed in a solution of 1 kilo of arsenate of lead to 150 liters of water killed the insects within 48 hours. Paris green mixed with lime at the rate of 1 kilo of Paris green to 20 kilos of lime, and blown on the plants from a hand bellows also proved very efficient. We would recommend that the hand bellows be used. This apparatus is easily handled, requires no water and can be operated by one man. It can be taken up or laid down at pleasure, and it costs but little. Experience with insecticides in these Islands, however, indicates that the time is not yet at hand for the use of poisons by the majority of the Filipino planters, as they seem to forget that a poison is just as dangerous to live stock as it is to the pest.

Since the worms pupate in the ground about 7.5 centimeters below the surface, great numbers of the pupae may be destroyed by plowing the ground, as this will expose them to the sun, which if strong will kill them. The mature moths are of a light tan color with buff-colored underwings and a dark spot on the lower margin of each wing. These moths may be destroyed by placing lanterns in the field at night with pans of water underneath. The moths are attracted to the light and fall into the water where they will drown.

Among other leaf feeders that attack the tobacco plant is a large dark-gray caterpillar with white and black markings on the back. These caterpillars feed mainly at night and seek the shade during the day. The best method of combating them in this country is to keep them picked off by hand and to destroy them by cultivation. As these caterpillars, like those of the preceding species, pupate underground they may be killed by being turned up and exposed to the sun and rains.

Another insect responsible for considerable damage is the larvæ of a small Pyralid moth. The eggs of this moth are laid either on the

ground near the plant or on the stalk. The young larva eats its way into the young plant at the point where it enters the ground. The grub bores upward and as it nears maturity eats outward until it is almost through the bark of the plant, leaving only a thin shell. It then spins a small cocoon of white silky material and transforms into a pupa. From this pupa emerges a small dark gray moth which is about 0.5 centimeters in length. Plants that contain larvæ of this species are always stunted and the leaves droop. Often the plants are blown over by a light wind, as the entire heart or pith of the stalk is eaten out. When such plants are noted they should be pulled up and burned. It may be possible to combat these insects by dipping the plants at the time of transplanting from seed bed to field in a strong mixture of lead arsenate, which would probably kill the insects as they eat their way into the stalk. This is one of the worst enemies of young tobacco plants, for the entire plant is destroyed by the one insect, and should the species ever become numerous it will constitute quite a check to tobacco culture.

There are other insects which affect tobacco, such as leaf-feeding beetles and some sucking bugs, but as they do not confine their attention entirely to the tobacco plant the damage done is not so great.

Some insects which are really beneficial are killed through ignorance, noticeable among these are the small lady-bird beetles and the larvæ of the sun flies. Both of these feed on the colonies of plant lice which attack the tobacco, especially the beetles, which feed on them both during the larval and mature states. The sun fly larvæ feed on the plant lice and destroy them in great numbers. As plant lice are indirectly responsible for considerable loss of tobacco by the growth of a fungus upon the leaves, it will be seen that the beetles and sun flies should be protected rather than killed.

TOPPING AND SUCKERING.

It should be remembered that the ultimate object of the tobacco plant itself is to produce seeds and not leaves. After the flowering bud appears at the top of the plant much of the nutritive substance, that would otherwise be stored in the leaves, goes to the top of the plant for the development of the seeds and the small top leaves; the lower leaves will then be thin and light. If it is desired that the lower leaves should be heavier, then the seed pods should be removed.

Just how much of the top of the plant should be removed with the flowering bud depends upon the variety of the tobacco, the climatic condition at the time the operation is performed, the physical condition and fertility of the soil, the vigor of the plant, and the quality of leaf it is desired to produce.

When tobacco is grown on a fertile soil, and it is desired to produce a light, thin leaf for cigar-wrapper purposes, the plants should be topped high; tobacco grown on poor soil should be topped lower.

A short time after the flowering bud has been removed, suckers will appear in the axils of the leaves and develop with great rapidity. If these suckers are allowed to develop, they will rob the parent plant. They should be removed just as soon as they appear.

In some tobacco-producing countries, where it is desired to secure a light, thin leaf for cigar-wrapper purposes, the plants are not topped, but the seed heads are allowed to develop in order to draw some of the nutritive substance out of the leaves and make them thinner and lighter.

Two crops of suckers generally appear in the axils of the leaves and both should be removed. After the lower leaves of the plant have been gathered, one or two suckers from the ground nodes may be allowed to develop; then, just as soon as all the leaves from the main plant have been harvested, cut out the old stalk and remove all but one sucker from the stub. If the season is favorable and this second or sucker crop is cultivated properly, a fairly good quality of tobacco may be obtained that will be suitable for fillers in cheap cigars.

SELECTION OF SEED.

At the present time no attention is paid to seed selection, which is the most important factor in the production of a uniform type of tobacco. The selection of seed not only affects the quality and quantity of the crop, but also determines the type of tobacco that will be produced. No farmer should grow a poor type of tobacco when it costs no more to grow an improved one.

Tobacco is a plant that, if neglected, will cross breed and split up into many different types. The required conditions for cross-breeding could hardly be more favorable than those that are to be found in the tobacco districts of the Philippine Islands. We seldom find a tobacco grower in the Philippines who makes any attempt to select his seed from good, healthy plants, or from any one distinct type of plants; as a result not one field of a distinct type of tobacco can be found, but instead, eight to twelve types are usually found growing in the same field. The general practice of the Filipino planter is to gather seed from any and all plants, suckers included; the large, small, and worm-eaten pods are saved together, and from such seed the plants for the following crop are secured.

Seed should be selected only from the plants which most nearly approach the type desired. When selecting a plant for seed it should be studied thoroughly and note taken of its many important parts, such as place to be grown, use to be made of leaf, height, perfection and number of leaves, uniformity of leaves, position of leaves, length of internodes, size of stalk, rapidity of growth, etc. The quality of leaf should be judged with regard to size, shape (see text figures Nos. 2, 3), texture, color, veins, uprightness, etc. As it is impossible to set down

any hard and fast rules as to the type of tobacco that is best suited to all soils, the grower must use his own judgment and select toward a good type which he thinks his soil is best adapted to producing.

FIG. 2. TOBACCO LEAF, DESIRABLE SHAPE. (A LEAF OF THIS SHAPE WILL FURNISH EIGHT WRAPPERS.)

FIG. 3. TOBACCO LEAF, UNDESIRABLE SHAPE. (A LEAF OF THIS SHAPE WILL FURNISH FOUR WRAPPERS.)

The flowers of the tobacco plant are able to pollinate themselves, but when allowed to bloom in their natural way, are cross-pollinated by insects which are attracted to the flowers by the sweet fluid in the bottom of the flower tube. In visiting flower after flower the fine pollen dust which sticks to the body of the insect is carried from the flowers of one plant to those of another and cross-pollination takes place. In this way a good plant may be crossed with a very poor one and plants grown from such seed are likely to be undesirable and not closely resemble either of the parent plants. To prevent selected plants from becoming crossed with poor ones, it is necessary to protect the flowers from

PLATE II. PLANT OF STAND-UP-BURLEY TOBACCO. SHOWING METHOD OF
SAVING SEED UNDER BAG TO PREVENT CROSSING.

the visits of insects by covering the seed head with a paper bag. Before doing this all the suckers, leaves and lateral branches immediately below the seed head should be removed. Tie the mouth of the bag around the stalk below the remaining flower buds before they open. After three or four days the bag should be removed long enough to shake out the old dead flowers and break off the newly developed suckers. It should be replaced at once and the process repeated at intervals of four to five days. Not over 25 or 30 seed capsules should be allowed to develop on one plant, and after they have finished blooming the paper bag should be removed and the head exposed to the sunlight.

When the seeds are fully matured and the capsules have taken on a brown color the head should be removed with 4 or 5 inches of the stalk and hung in a dry place where there is a free circulation of air. Even in seeds selected in this careful manner, there will be many light seeds which are small, weak and undeveloped that are likely to produce weak, slow-growing plants. These should be taken out and only the large, strong heavy seeds used in sowing the seed bed. With this end in view, several good machines for cleaning tobacco seed, that is, for separating the weak, light seed from the strong, heavy seed, have been constructed, and any farmer can have his tobacco seed cleaned free of charge by sending it either to the Bureau of Agriculture in Manila or to the tobacco experiment station at Ilagan, Isabela. In moist or damp weather the seeds are liable to mold or rot and it is better to hull them out of the capsules and send them at once to be cleaned. Mix the good seed with powdered charcoal, put in a bottle and seal it so no outside air can enter.

HARVESTING AND CURING. ✓

This is one of the most important operations in the production of good tobacco, as a good crop can easily be ruined if it is not harvested at the proper time, and afterwards properly cured.

Some Filipino planters harvest their tobacco too green, and others harvest it over-ripe. When the leaves are harvested too green they have a dark color and bitter taste when cured. When the color of the leaves changes from a rank green to a light shade of green and a few yellow spots appear on them, they are ready to harvest.

Tobacco leaves should never be gathered when there is dew or rain on them, as the drops of water will cause dark spots to form on the leaves when cured. As soon as the leaves are broken from the stalk, they should be immediately removed to the curing shed. Thirty to thirty-five leaves should be strung on a stick, back to back and face to face, leaving a space of about $1\frac{1}{4}$ centimeters between each leaf.

After the stringing is finished they should then be removed to the interior of the curing shed and hung up in such a manner as to allow the free circulation of air. No leaves should be hung near the

ground, for if so hung they are liable to mould and rot during wet weather.

The practice of many planters of stringing from 150 to 250 leaves on a single stick is a very bad one, for when strung in this manner no air can circulate through them and to prevent them from moulding or rotting it is necessary to place them in the sun for several days.

Curing is a process through which the cells of the leaf must pass. It is influenced by the structure of cells and climatic conditions. The time necessary for the curing of a tobacco leaf depends upon its ripeness and condition of the weather during the curing. When the curing leaves are exposed to the sun for any length of time the sap is evaporated, the chlorophyl in the leaf cells is killed and the leaf is dried instead of cured, which ruins its flavor, color and suppleness. If rain or dew falls on the tobacco while it is curing it will be much darker in color.

CURING SHEDS.

Very little attention has heretofore been given to this subject and there is certainly great need for improving the present methods of curing tobacco in these Islands. But few of the planters have constructed proper curing sheds, and the larger part of the tobacco crop is cured, or *dried*, in the sun and afterwards placed in, around, or under the dwelling houses of the planters. This is a bad practice, as many of the leaves that would make a first-class cigar wrapper, if cured properly, are ruined by these methods; and, on account of the great variation in the color and texture of the leaves, the manufacturer is compelled to buy a large number of bales of tobacco in order to secure the wrappers required in the production of first-class cigars.

To properly cure a crop of tobacco, so as to get a uniform color, is a delicate and important operation. It should be remembered that the object of curing is not to dry the leaf, but to fix the qualities of the leaf as to color, strength, elasticity, flavor, and aroma. These desirable qualities can not be secured in the cured tobacco if it is allowed to cure or dry in the sun.

It is impossible to properly cure tobacco without first having a well-ventilated curing shed. It is within the means of most tobacco planters to construct such a shed. The materials used in building curing sheds are bamboo and cogon, and these are available in every tobacco district.

The curing shed should be located on slightly elevated ground, where there is no danger of overflow or standing water. If a better form of shed is desired the *harigues* (posts) should be of hard wood, set deep in the ground, and well braced as a precaution against heavy winds. The sides of the shed should be about 3 meters high, and the *harigues* placed along the sides 3 meters apart. The roof may be made of cogon or nipa, and the sides of finely woven bamboo, with large windows one

PLATE III. TOBACCO CURING SHED IN ISABELA PROVINCE.

meter apart, so constructed that the air may be freely admitted or excluded as the weather conditions may demand. It is essential that the weather conditions be under perfect control while the process of curing is going on.

A shed 10 meters wide and 36 meters long, with the sides 3 meters high, is sufficiently large to cure about one hectare of tobacco. The lower leaves of the plant, which ripen first, can be taken off, cured, and placed in the *mandala*¹ before the top leaves are ripe and ready to be harvested.

After the tobacco is thoroughly cured it should remain hanging in the shed until the moist atmosphere softens the stems and tissues of the leaves so that they may be taken down and placed in mandalas without breaking or other injury.

Many planters damage their tobacco by taking it down dry and pouring water over it to soften the leaves preparatory to placing in the mandala. When the leaves are treated in this manner they take on a darker shade, and their flavor and aroma are greatly injured.

FERMENTING.

The green tobacco leaf has a dark, sticky gum and during the curing process the juice or fluid in the leaf cells evaporates and leaves this gum with the leaf. After the leaves are cured, if they are moist and in a pliable condition, and packed together in large bulk, fermentation starts the heat causing a change in the composition of the leaf. This change is caused largely by the oxidizing action of soluble ferments. Good tobacco will lose from 10 to 15 per cent of its weight while undergoing this change. If the tobacco is fermented properly the desirable qualities, such as flavor and aroma, are fixed and the color of the leaves made uniform. The fermentation must be carefully controlled and the leaves from the bottom, middle, and top of the plants should be fermented in different piles. As the bottom leaves are very thin and contain only a small amount of gum the leaf cells break down sooner and the change is more rapid than in the middle leaves of the plant. The top leaves of the plant are still heavier and require a higher temperature to break down.

In order to properly ferment tobacco it is necessary to have a large quantity of leaves in the mandala, as a large mandala will generate more heat and ferment better than a small one. Since the majority of the planters do not have a sufficient amount of tobacco to ferment properly, it is better that the buyers do the fermenting.

In fermenting tobacco a platform should be built 15 or 20 centimeters above the surface of the ground and this platform covered

¹ A *mandala* is a pile of cured tobacco arranged in compact form for the purpose of fermenting.

with a heavy cloth so that moisture from the ground will not penetrate the mandala. The mandala may be built either circular or square, and the outer row of tobacco should be laid down first, placing the tips toward the center. Another row should then be laid down, allowing the second row to overlap about two-thirds of the first. A third row should be laid on this in the same way with the tips pointing toward the center. The second layer should be made in the same manner and the process continued until the mandala is 1.5 or 2 meters high. The diameter of the base of the mandala should be about 2 meters. After the mandala is completed it should be covered with blankets.

If the tobacco contains a sufficient amount of moisture when put down it will generate sufficient heat to have a daily rise in temperature of from 5° to 8° F. If the temperature rises too rapidly the mandala should be torn down and rebuilt. During the process of rebuilding, the tobacco that was in the center of the old mandala should be placed in the outer edges, top, and bottom of the new one.

If the tobacco leaves are exceedingly moist when first put down it may be necessary to tear down and rebuild the mandala five or six times. In fermenting tobacco a thermometer should be used for measuring the temperature. In building the mandala a bamboo tube should be laid down in the center with one end extending to the edge. The thermometer may be tied to a stick and inserted through this bamboo tube to the center of the mandala. The outer end of the tube should be kept stuffed with rags so the temperature will not be affected; when it is desired to take the temperature the rags may be removed, the thermometer drawn out and read and again inserted.

After the tobacco is fermented it should be graded. At present the leaves are graded according to length and soundness, instead of quality and color as they should be. As a result one bale may contain leaves suited for filler, binder, and wrapper, whereas, if it was graded as stated, a bale marked first class would be No. 1 wrapper; second class, No. 2 wrapper; third class, binders; fourth class, fillers, etc.

CONCLUSION. ✓

The quality of the tobacco produced in any locality is determined in part by climatic and soil conditions, and in part by the methods of cultivation and handling.

The tobacco grown in these Islands can be greatly improved by adopting proper methods of seed selection, cultivation, harvesting, curing and fermenting. It costs no more to produce a good variety of tobacco, which gives a better yield and quality, than it does to grow an unimproved irregular variety.

The planters living in those districts where the cultivation of tobacco

is destined to remain their chief occupation, should endeavor to gain a better knowledge of tobacco culture, and they should construct permanent curing sheds to be used for the sole purpose of curing the crop. It is very important, also, that the planters know the requirements of the manufacturers and aim to produce the kind of tobacco desired. The willingness of manufacturers to pay increased prices for better qualities of tobacco makes the cultivation of this crop very profitable to the industrious and intelligent planter who is willing to adopt better methods.

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